

COPY

EXHIBIT 1a.



PLANNING DEPARTMENT

TOWN OF GRAFTON  
GRAFTON MEMORIAL MUNICIPAL CENTER  
30 PROVIDENCE ROAD  
GRAFTON, MASSACHUSETTS 01519  
(508) 839-5335 ext 1120 • FAX (508) 839-4602  
planningdept@graffon-ma.gov  
www.graffon-ma.gov

12

APPLICATION FOR SPECIAL PERMIT

Application No. MRSP 2019-12

APPLICANT & PROPERTY OWNER INFORMATION

NAME Applicant: Circle Assets, LLC

STREET 291 Main Street Suite 8

CITY/TOWN Northborough

STATE MA

ZIP 01532

TELEPHONE 508-393-3784

NAME OF PROPERTY OWNER (if different from Applicant) See Attached list of owners and Deed References

Deed recorded in the Worcester District Registry of Deeds Book \_\_\_\_\_ Page \_\_\_\_\_

SITE INFORMATION:

STREET AND NUMBER 124 R. North Street, 73 R. Old Worcester Road 4 Village Lane, 25 Magnolia Lane.

ZONING DISTRICT R40

ASSESSOR'S MAP 30 / 39

LOT #(S) 45, 53 26A & 250 / 3 & 4A

LOT SIZE 73.5 Acres

FRONTAGE 70.7 North St. & 106.9 Magnolia Lane

CURRENT USE Vacant

PROJECT/PLAN INFORMATION:

PLAN TITLE Preliminary Plan of North Street Subdivision

PREPARED BY (name/address of PE/Architect) Connorstone Engineering, Inc.

DATES June 19, 2019

Use for which Special Permit is sought: (refer to § 3.2.3.1 of the Zoning Bylaw - Use Regulation Table):

Section 5.3 Flexible Development

Cite all appropriate sections of the Zoning By-Law which pertain to this Application, Use and Site:

TO THE GRAFTON PLANNING BOARD:

The undersigned, being the APPLICANT named above, hereby applies for a SPECIAL PERMIT to be granted by the Planning Board and certifies that, to the best of APPLICANT'S knowledge and belief, the information contained herein is correct and complete.

RECEIVED

Property Owner's Signature (if not Applicant)

AUG 14 2019

Victor Chinn-trustee Date: 6/26/19

MANAGER

PLANNING BOARD  
GRAFTON MA



# EXHIBIT 1b.

# COPY

**TOWN OF GRAFTON**  
 GRAFTON MEMORIAL MUNICIPAL CENTER  
 30 PROVIDENCE ROAD  
 GRAFTON, MASSACHUSETTS 01519  
 (508) 839-5335 ext 1120 • FAX (508) 839-4602  
 www.grafton-ma.gov  
 planningdept@grafton-ma.gov

PLANNING DEPARTMENT

AK

## APPLICATION FOR APPROVAL OF A PRELIMINARY PLAN

Application No. MRSP 2019-12

### APPLICANT & PROPERTY OWNER INFORMATION

NAME Applicant: Circle Assets, LLC  
 STREET 291 Main Street, Suite 8 CITY/TOWN Northborough  
 STATE MA ZIP 01532 TELEPHONE 508-393-3784  
 NAME OF PROPERTY OWNER (if different) See Attached list of owners and Deed References  
 Deed recorded in the Worcester District Registry of Deeds Book \_\_\_\_\_ Page \_\_\_\_\_

### CONTACT INFORMATION

NAME Scott Goddard, Circle Assets, LLC  
 STREET 291 Main Street, Suite 8 CITY/TOWN Northborough  
 STATE MA ZIP 01532 TELEPHONE 508-393-3784

### PROJECT LOCATION:

STREET AND NUMBER 124 R. North Street, 73 R. Old Worcester Road, 4 Village Lane, 25 Magnolia Lane.  
 ZONING DISTRICT R40 ASSESSOR'S MAP 30 LOI #(S) 26A & 250, 45, 53  
39 3 & 4A

### PROJECT/PLAN INFORMATION:

PLAN TITLE Preliminary Plan of North Street Subdivision PLAN DATED: June 19, 2019  
 PREPARED BY (Engineer) Connorstone Engineering Inc.  
 STREET 10 Southwest Cutoff CITY/TOWN Northborough  
 STATE MA ZIP 01532 TELEPHONE 508-393-9727

The undersigned, being the applicant as defined under Chapter 41, Section 81-L, for approval of a proposed subdivision shown on the above referenced plan being land bounded as follows:

hereby submits said plan as a **PRELIMINARY** plan in accordance with the Rules and Regulations of the Grafton Planning Board and makes application to the Board for approval of said plan. The undersigned's title to said land is derived from See attached deeds

by deed dated \_\_\_\_\_ and recorded in the Worcester District Registry of Deeds Book \_\_\_\_\_, Page \_\_\_\_\_ registered in the \_\_\_\_\_ Registry District of Land Court, Certificate of Title No. \_\_\_\_\_; and said land is free of encumbrances except for the following: \_\_\_\_\_

The undersigned hereby applies for the approval of said **PRELIMINARY** plan by the Board, and in furtherance thereof hereby agrees to abide by the Board's Rules and Regulations.

**RECEIVED** AK MANAGER CIRCLE ASSETS LLC Date: 6/26/19  
 Applicant's Signature  
 Property Owner's Signature (if not Applicant) Victoria Chimento-trustee Date: 6/26/19  
AK MANAGER

AUG 14 2019

PLANNING BOARD  
GRAFTON, MA

COPY

RECEIVED



**TOWN OF GRAFTON**  
GRAFTON MEMORIAL MUNICIPAL CENTER  
30 PROVIDENCE ROAD

GRAFTON, MASSACHUSETTS 01519  
Phone: (508) 839-5335 ext 1170 • FAX: (508) 839-4602  
www.grafton-ma.gov

AUG 14 2019

**PLANNING BOARD**  
GRAFTON, MA

TREASURER / COLLECTOR

**EXHIBIT** 1c.

## Certificate of Good Standing

Applicants seeking permits with the Town of Grafton must submit this completed form at the time of application. When all obligations are paid to date, you must attach this "Certificate of Good Standing," with your application. Delinquent bills must be paid in full before the appropriate department accepts your application. Please make arrangements to pay these outstanding bills at the Collector's Office.

**Please note: it can take up to three (3) business days to process each request.**

Please check all that apply and indicate if permit(s) have been issued.

	Permit Issued?			Permit Issued?	
	Yes	No		Yes	No
<input type="checkbox"/> Building - Inspection(s)	_____	_____	<input type="checkbox"/> Septic System	_____	_____
<input type="checkbox"/> Building - Electric	_____	_____	<input type="checkbox"/> Conservation	_____	_____
<input type="checkbox"/> Building - Plumbing	_____	_____	<input checked="" type="checkbox"/> Planning	_____	✓
<input type="checkbox"/> Board of Health	_____	_____	<input type="checkbox"/> Other	_____	_____

Other Permit: \_\_\_\_\_

Scott Goddard

Petitioner Name

291 Main St., Suite 8

Petitioner Address

Northborough, MA , 01532

City, State, Zip

(508)393-3784

Phone

Circle Assets, LLC

Property Owner / Company Name

124 R. North St.

Property Address

Grafton, MA

City, State, Zip

Please Call Tom Rebula @ (508) 479-9195  
when complete.

Date:	Current	Delinquent	N/A
Real Estate	✓		
Personal Property			✓
Motor Vehicle Excise	✓		
Disposal	✓		
General Billing			✓

Christine Atchue

Treasurer / Collector Name (please print)

Christine Atchue

Treasurer / Collector Signature

5/7/19

Date

*Ken O'Brien*  
Ken O'Brien, MAA  
Grafton Data Collector

ID	Site Address	Owner	Co-Owner Name	Address	Town	State	Zip	Book	Page
030.0-0000-0014.0	14 MAGNOLIA LANE	CAMPISI JOSEPH S JR	CAMPISI AMY A	14 MAGNOLIA LANE	N GRAFTON	MA	01536	41737	141
030.0-0000-0016.0	16 MAGNOLIA LANE	LABOUNTY DENNIS	LABOUNTY SHARON	16 MAGNOLIA LANE	N GRAFTON	MA	01536	37971	251
030.0-0000-0018.0	18 MAGNOLIA LANE	JACKSON KEVIN P	JACKSON EMMA K	18 MAGNOLIA LANE	N GRAFTON	MA	01536	35702	239
030.0-0000-0019.0	19 MAGNOLIA LANE	LYVER MICHAEL J	LYVER LORI A	19 MAGNOLIA LANE	N GRAFTON	MA	01536	41166	17
030.0-0000-0022.0	23 STOCKWELL FAR	HEYN EILEEN M		23 STOCKWELL FARM	N GRAFTON	MA	01536	23381	26
030.0-0000-0023.0	21 STOCKWELL FAR	PIDACKS LEE W	PIDACKS MARIA M	21 STOCKWELL FARM	N GRAFTON	MA	01536	55832	384
030.0-0000-0024.0	17 STOCKWELL FAR	JOUBERT FRANCIS W	JOUBERT MICHELLE C	17 STOCKWELL FARM	N GRAFTON	MA	01536	14845	70
030.0-0000-0025.0	2 VILLAGE LANE	MAROTTA ANTHONY M	MAROTTA EMILY S	2 VILLAGE LANE	N GRAFTON	MA	01536	57263	143
030.0-0000-0026.0	4 VILLAGE LANE	MOHAMMED ASIM	BUKHARI MEHVEEN	4 POND COURT	CHERRY VALLE	MA	01611	57601	373
030.0-0000-0026.A	4 REAR VILLAGE LAN	CHIMENO NICHOLAS J	MARYBETH REALTY TR	134 WEST SPRUCE ST	MILFORD	MA	01757	22261	264
030.0-0000-0027.0	3 VILLAGE LANE	BABB LAWRENCE J	BABB MARTHA T	3 VILLAGE LANE	N GRAFTON	MA	01536	29733	121
030.0-0000-0028.0	1 VILLAGE LANE	SHRAYER ERIC A		1 VILLAGE LANE	N GRAFTON	MA	01536	47082	370
030.0-0000-0029.0	11 STOCKWELL FAR	HEFFERNAN PATRICK J	HEFFERNAN KATHLEEN	11 STOCKWELL FARM	N GRAFTON	MA	01536	53952	314
030.0-0000-0210.0	21 MAGNOLIA LANE	JONES CHRISTOPHER E		21 MAGNOLIA LANE	N GRAFTON	MA	01536	39948	176
030.0-0000-0230.0	23 MAGNOLIA LANE	CACCIAPOUTI RICHARD	23 MAGNOLIA LANE REF	23 MAGNOLIA LANE	N GRAFTON	MA	01536	48601	32
030.0-0000-0250.0	25 MAGNOLIA LANE	LABOUNTY DENNIS, CL	(MAGNOLIA FARMS ASS)	P.O. BOX 163	N GRAFTON	MA	01536	49791	386
030.0-0000-0270.0	27 MAGNOLIA LANE	OSIT SHARI		27 MAGNOLIA LANE	N GRAFTON	MA	01536	45480	96
039.0-0000-0003.0	124 NORTH STREET	CIRCLE ASSETS LLC		291 MAIN STREET, SUIT	NORTHBOROU	MA	01532	53822	331
039.0-0000-0009.0	7 STOCKWELL FARM	COOLBAUGH BRIAN L		7 STOCKWELL FARM	N GRAFTON	MA	01536	34836	78

COPY

RECEIVED

EXHIBIT 1 d.

AUG 14 2019

PLANNING BOARD  
GRAFTON, MA

ID	Site Address	Owner Name	Co-Owner Name	Owner Address	Town	State	Zip	Book	Page
110/029.0-0000-0001.A	148 NORTH STREET	SIMPSON MARVIN	SIMPSON AMY	148 NORTH STREET	GRAFTON	MA	01519	43362	366
110/029.0-0000-0002.0	140 NORTH STREET	COFFEY KEVIN D	COFFEY SANDRA L	74 SUMMER STREET	WESTBOROUGH	MA	01581	57975	292
110/029.0-0000-0002.A	142 NORTH STREET	FITZGERALD JEAN M		17 HUTCHINS STREET	SHREWSBURY	MA	01545	54956	219
110/029.0-0000-0004.0	143 NORTH STREET	RIVARD GERALD J	RIVARD KAREN M	143 NORTH STREET	GRAFTON	MA	01519	30653	389
110/029.0-0000-0004.A	135 NORTH STREET	MUSTACCHIO PAUL L	MUSTACCHIO YUEHER	135 NORTH STREET	GRAFTON	MA	01519	20483	294
110/029.0-0000-0004.B	137 NORTH STREET	SARKISIAN SEVAG A	SARKISIAN ALIN V	137 NORTH STREET	GRAFTON	MA	01519	48099	210
110/029.0-0000-0004.C	139 NORTH STREET	LITTLE TIMOTHY M	LITTLE AMY W	139 NORTH STREET	GRAFTON	MA	01519	46914	6
110/029.0-0000-0004.D	8 WESSON STREET	DALY JOHN P	DIGLORIA DIANE L	145 NORTH STREET	GRAFTON	MA	01519	51555	118
110/029.0-0000-0004.E	145 NORTH STREET	DALY JOHN P	DIGLORIA DIANE L	145 NORTH STREET	GRAFTON	MA	01519	51555	115
110/029.0-0000-0017.A	138 NORTH STREET	TERRY ROBERT M	TERRY LINDA M	138 NORTH STREET	GRAFTON	MA	01519	18906	152
110/029.0-0000-0017.B	136 NORTH STREET	HUTCHISON HOWARD B	HUTCHISON LILLIAN M	136 NORTH STREET	GRAFTON	MA	01519	6630	322
110/029.0-0000-0036.0	26 WESSON STREET	SUPSKI CONRAD P	SUPSKI THERESA	26 WESSON STREET	N GRAFTON	MA	01536	5070	193
110/029.0-0000-0038.0	18 WESSON STREET	KELLY JILLIAN	WELCH MICHAEL	18 WESSON ROAD	N GRAFTON	MA	01536	55331	284
110/029.0-0000-0038.A	150 NORTH STREET	FARRAH MICHAEL S	FARRAH RENEE	150 NORTH STREET	GRAFTON	MA	01519	23075	048
110/030.0-0000-0001.A	28 WESSON STREET	RENAUD DANIELLE K	WALKER TIMOTHY J JR	28 WESSON STREET	N GRAFTON	MA	01536	46064	137
110/030.0-0000-0001.B	30 WESSON STREET	DUSSAULT SUSAN C TRUSTEE	WILLIAM F DUSSAULT IRREVO	30 WESSON STREET	N GRAFTON	MA	01536	51434	288
110/030.0-0000-0001.C	32 WESSON STREET	BOE LANCE R		32 WESSON STREET	N GRAFTON	MA	01536	45478	391
110/030.0-0000-0010.0	10 MAGNOLIA LANE	ROSSI CARIG	ROSSI MELISSA	10 MAGNOLIA LANE	N GRAFTON	MA	01536	40147	172
110/030.0-0000-0012.0	12 MAGNOLIA LANE	ALEXANDER JENNIFER	RAMAKRISHNAN ANAND	12 MAGNOLIA LANE	N GRAFTON	MA	01536	38188	248
110/030.0-0000-0014.0	14 MAGNOLIA LANE	CAMPISI JOSEPH S JR	CAMPISI AMY A	14 MAGNOLIA LANE	N GRAFTON	MA	01536	41737	141
110/030.0-0000-0016.0	16 MAGNOLIA LANE	LABOUNTY DENNIS	LABOUNTY SHARON	16 MAGNOLIA LANE	N GRAFTON	MA	01536	37971	251
110/030.0-0000-0018.0	18 MAGNOLIA LANE	JACKSON KEVIN P	JACKSON EMMA K	18 MAGNOLIA LANE	N GRAFTON	MA	01536	35702	239
110/030.0-0000-0026.0	4 VILLAGE LANE	MOHAMMED ASIM	BUKHARI MEHVEEN	4 POND COURT	CHERRY VALLEY	MA	01611	57601	373
110/030.0-0000-0026.A	4 VILLAGE LANE	CHIMENO NICHOLAS J TRUSTEE	MARYBETH REALTY TRUST	134 WEST SPRUCE ST	MILFORD	MA	01757	22261	264
110/030.0-0000-0027.0	3 VILLAGE LANE	BABB LAWRENCE J	BABB MARTHA T	3 VILLAGE LANE	N GRAFTON	MA	01536	29733	121
110/030.0-0000-0031.0	31 MAGNOLIA LANE	RUSH THOMAS A II	RUSH MICHELE L	31 MAGNOLIA LANE	N GRAFTON	MA	01536	48176	300
110/030.0-0000-0033.0	33 MAGNOLIA LANE	DIPAOLI JAMES	DIPAOLI CHRISTINA	33 MAGNOLIA LANE	N GRAFTON	MA	01536	46672	117
110/030.0-0000-0041.0	41 MAGNOLIA LANE	CATALANOTTI ROBERT G	CATALANOTTI KAREN E	43 MAGNOLIA LANE	N GRAFTON	MA	01536	53782	100
110/030.0-0000-0045.0	45 MAGNOLIA LANE	LABOUNTY DENNIS, CLOUGH H.	MAGNOLIA FARMS ASSOCIATI	P.O. BOX 163	N GRAFTON	MA	01536	49791	386
110/030.0-0000-0053.0	45 REAR MAGNOLIA L	LABOUNTY DENNIS, CLOUGH H.	MAGNOLIA FARMS ASSOCIATI	P.O. BOX 163	N GRAFTON	MA	01536	49791	386
110/030.0-0000-0200.0	20 MAGNOLIA LANE	MIELE THOMAS J		20 MAGNOLIA LANE	N GRAFTON	MA	01536	41025	73
110/030.0-0000-0210.0	21 MAGNOLIA LANE	JONES CHRISTOPHER B		21 MAGNOLIA LANE	N GRAFTON	MA	01536	39948	176
110/030.0-0000-0230.0	23 MAGNOLIA LANE	CACCIAPOUTI RICHARD J & JES	23 MAGNOLIA LANE REALTY T	23 MAGNOLIA LANE	N GRAFTON	MA	01536	48601	32
110/030.0-0000-0250.0	25 MAGNOLIA LANE	LABOUNTY DENNIS, CLOUGH H.	MAGNOLIA FARMS ASSOCIATI	P.O. BOX 163	N GRAFTON	MA	01536	49791	386
110/030.0-0000-0270.0	27 MAGNOLIA LANE	OSIT SHARI		27 MAGNOLIA LANE	N GRAFTON	MA	01536	45480	96
110/030.0-0000-0290.0	29 MAGNOLIA LANE	FULLER JOSHUA A	FULLER MICHELLE M	29 MAGNOLIA LANE	N GRAFTON	MA	01536	46291	308
110/038.0-0000-0001.0	124 NORTH STREET	WHITE ANDREW		124 NORTH STREET	GRAFTON	MA	01519	50851	383
110/038.0-0000-0004.0	116 REAR NORTH STR	BABOWITCH JOSEPH		29 WATERVILLE STRE	N GRAFTON	MA	01536	59831	128
110/038.0-0000-0012.A	125 NORTH STREET	DUSSAULT MICHAEL	DUSSAULT DAWN	125 NORTH STREET	GRAFTON	MA	01519	30573	41
110/038.0-0000-0012.B	127 NORTH STREET	PADENI JOSEPH L JR	PADENI BARBARA A	127 NORTH STREET	GRAFTON	MA	01519	5511	108
110/038.0-0000-0059.0	132 NORTH STREET	TORTESON ROBERT J	TORTESON TRACY E	132 NORTH STREET	GRAFTON	MA	01519	49699	215
110/038.0-0000-0060.0	130 NORTH STREET	DAVIS AUDREY J	DAVIS MARQUIS H	130 NORTH STREET	GRAFTON	MA	01519	17788	111
110/038.0-0000-0061.0	128 NORTH STREET	MAYEENUDDIN JENNIFER L		128 NORTH STREET	GRAFTON	MA	01519	43103	296
110/038.0-0000-0062.0	126 NORTH STREET	DARLING PATRICIA		126 NORTH STREET	GRAFTON	MA	01519	44765	64
110/039.0-0000-0001.0	77 OLD WESTBORO R	DONAHUE TODD D	DONAHUE AMY BETH	77 OLD WESTBORO R	N GRAFTON	MA	01536	26685	0003
110/039.0-0000-0002.0	75 OLD WESTBORO R	SIMPSON JOHN E	SIMPSON CLAIRE B	75 OLD WESTBORO R	N GRAFTON	MA	01536	4314	429
110/039.0-0000-0003.0	124 REAR NORTH STR	CIRCLE ASSETS LLC		291 MAIN STREET, SU	NORTHBOROUG	MA	01532	53822	331
110/039.0-0000-0004.A	73 REAR OLD WESTBC	CIRCLE ASSETS LLC		291 MAIN STREET, SU	NORTHBOROUG	MA	01519	58956	71
110/039.0-0000-0009.0	7 STOCKWELL FARM	F COOLBAUGH BRIAN L		7 STOCKWELL FARM	I N GRAFTON	MA	01536	34836	78
110/040.0-0000-0004.A	78 OLD WESTBORO R	FRAUMENI ALFRED		354 MAIN STREET	WAKEFIELD	MA	01880	42275	355

RECEIVED

COPY

AUG 14 2019

EXHIBIT 1e.

PLANNING BOARD  
GRAFTON, MA

PROJECT DESCRIPTION / NARRATIVE

---

North Street Preliminary Subdivision  
off North Street  
Grafton, MA

Prepared by:  
Connorstone Engineering, Inc.  
June 19, 2019

**Overview of Project and Site**

The proposed Subdivision is an Open Space Development located in Grafton, MA with frontage on North Street (near I-90) and Magnolia Lane, plus an access easement off Wesson Street.

This project comprises several parcels of land totaling 73.2 acres (plus easement areas):

- Assessors Map 30, Parcel 26A – Land-locked parcel near magnolia Lane
- Assessors Map 30, Parcel 3 – Large backland parcel with frontage on North St.
- Assessors Map 30, Parcel 4A – triangular parcel on I-90
- Roadway Easement over Assessors Map 30, Parcel 250 Off Magnolia Lane.
- Driveway & Utility Easement over Assessors Map 30, Parcel 45 & 53

The locus lies in the Residential R40 Zone - Single Family. The zoning allows for cluster type subdivision based upon a conventional plan yield, and includes bonus provisions. This project seeks to construct a flexible development of 37 lots with approximately 3.045 feet of interior roadways. Overall land area is 73.2 acres with about 52.5 acres to be preserved as open space.

Infrastructure will include the internal roadways, a connection to the Grafton Water District for potable water and fire protection, and a connection to the Grafton Municipal Sewer System. Private utilities will be installed underground. Stormwater infrastructure will be installed on site to match existing drainage patterns and flow discharge rates in conformance with all DEP Stormwater Guidelines.

Wetlands exist on the site as bordering vegetated wetlands, intermittent streams, and isolated wetlands. The wetland delineation was performed by Three Oaks Environmental LLC.

**Proposed Conventional Site Development**

To develop the site in conformance with the conventional subdivision regulations, a through road would be constructed connecting North Street to Magnolia Lane. The road would serve 32 residential lots. This layout would require approximately 4,540 linear feet of roadway, including a 500 foot cul-de-sac and two wetland crossings. Utilities would be connected to North Street and Magnolia Lane. The water line would be looped from North Street to Magnolia, and the sewer service would require a pump station with connection to Magnolia.

Stormwater would be collected in typical catch basin to manhole system, and piped to several detention/treatment areas located throughout the site. The Stormwater Management System would be designed in compliance with MassDEP Standards.

### **Proposed Flexible Site Development**

In accordance with the requirements of the Grafton Zoning By-Law, a plan of the Flexible Development Site Plan has been prepared demonstrating a cluster-style layout with 37 lots utilizing 3.045 feet of roadway for access. 52.5 acres of open space would be set aside. The minimum lot area would be reduced to 12,500 s.f. The proposal has utilize the bonus lot provisions as outlined further in this report.

The proposed roadway consists of a branching cul-de-sac off North Street (Roads A & B), and a smaller cul-de-sac off Magnolia Lane (Road C). The main cul-de-sac off North Street would be greater than 500 feet in length, and a secondary emergency access has been provided from the end of cul-de-sac to Wesson Street. The intersections at North Street and Magnolia Lane have been evaluated by Bristol Traffic and transportation, LLC, and a report has been attached herewith.

Roads A & B would provide water service from North Street. Sewer would be collected within the project through a gravity system then discharged to a proposed pump station. Sewerage would then be pumped to a new manhole in Wesson Street. Road C would provide water service from North Street. Sewer would be collected within the project through a gravity system then discharged to a proposed pump station. Sewerage would then be pumped to a new manhole in Magnolia Lane.

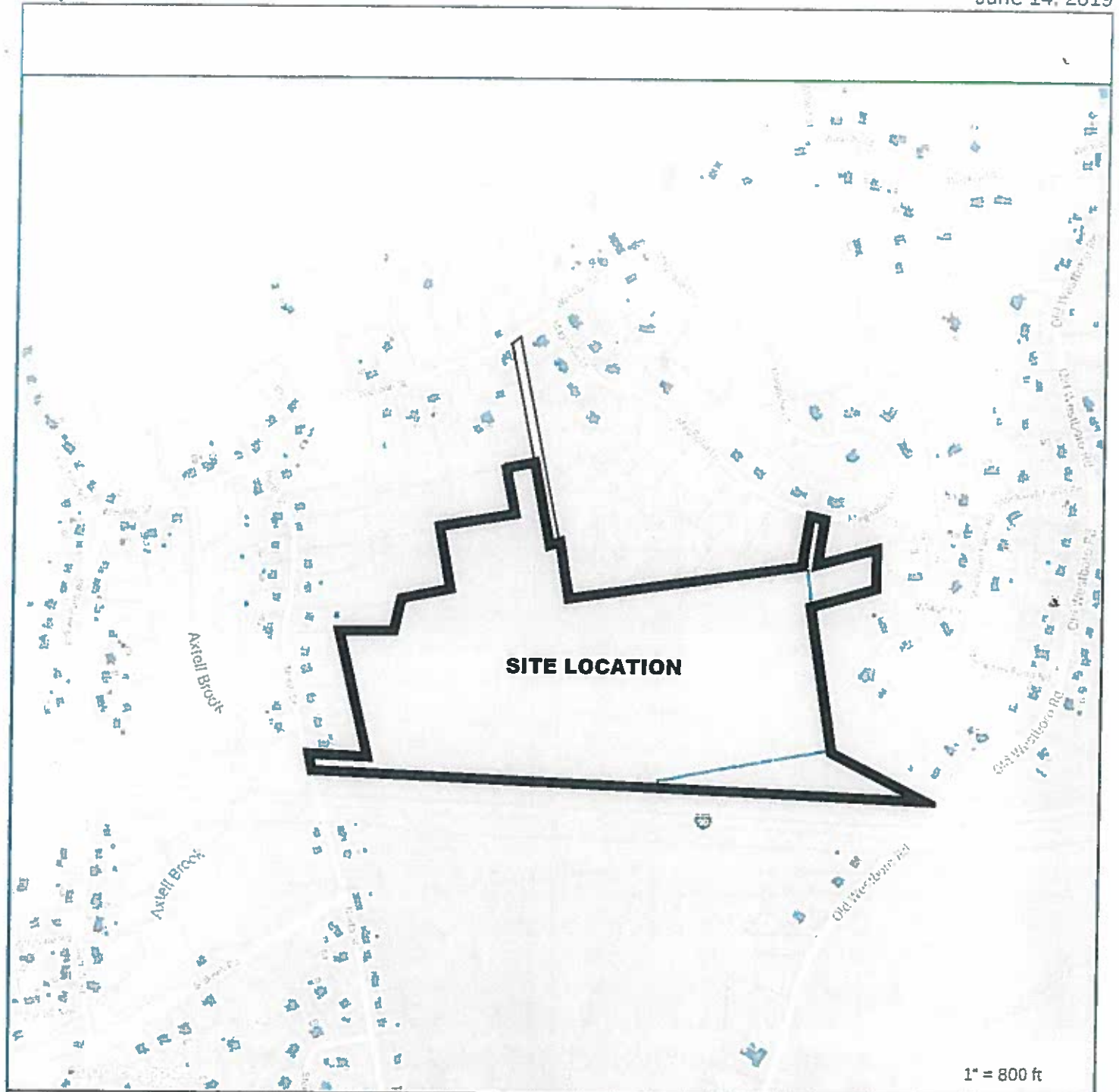
Stormwater would be collected in catch basins along the proposed street and directed to detention areas prior the being discharged. Discharge locations would match the pre-existing flow patterns with the wetlands generally flowing from east to west. All project drainage will be controlled within the limits of the site, appropriately mitigated and then released in a controlled manner to the receiving wetlands. The Stormwater management system would be designed to comply with the DEP Stormwater Management Standards, for recharge, treatment and mitigation of flows.

### **Comparison and Benefits of Flexible versus Conventional Development Plans**

By developing the project as a Flexible Development versus a Conventional Development, there are a number of major benefits that are realized. The most obvious difference between the two options is the area of the site that will be impacted. In the Flexible development the development area is limited to the western half of the site and small area near Magnolia Lane. The conventional development has impacts scattered throughout the site with far more land disturbance and wetland disturbance. The wetland disturbance would be reduced under the flexible plan, as shown below:

<i><b>Bordering Vegetated Wetland Disturbance</b></i>	
<i><b>Flexible</b></i>	<i><b>3,970 s.f.</b></i>
<i><b>Conventional</b></i>	<i><b>12,705 s.f.</b></i>

The combination of smaller lot sizes and shorter road length of the flexible development helps to reduce the level of sprawl that would be seen under the conventional development scenario. By confining development to the smaller areas approximately 70% of the site will remain in an undisturbed condition.



Property Information

Property ID 110/539.0-0000-0003.0  
 Location 124 REAR NORTH STREET  
 Owner CIRCLE ASSETS LLC



MAP FOR REFERENCE ONLY  
 NOT A LEGAL DOCUMENT

Town of Grafton, MA makes no claims and no warranties expressed or implied, concerning the validity or accuracy of the GIS data presented on this map.

Geometry updated 4/1/2018  
 Data updated 4/1/2019

## **ENVIRONMENTAL and COMMUNITY IMPACT ANALYSIS**

---

### **Executive Summary**

This Environmental and Community Impact Analysis is submitted in accordance with Section 3.3.4.1 of the Town of Grafton Subdivision Rules and Regulations Subdivision Regulations. This analysis includes the required assessment of the project to the natural environment and also contrasts the conventional and cluster subdivision proposals to the natural environment. The cluster type subdivision protects a vast amount of open space, eliminates a through road connection from North Street to Magnolia Lane.

### **Study Methodology**

Several methods for the fiscal impact of subdivision land development exist, and at two different levels: the micro and the macro levels. The method used here is the 'per capita, marginal cost method' "...acknowledged to be a highly appropriate method to use when doing a cost/benefit analysis of a proposed new housing development." (for reference see *Chapter 40R School Cost Analysis by The Commonwealth Housing Task Force from The Center for Urban and Regional Policy Northeastern University, May 14, 2005 at page 8*).

Communities have three basic revenue sources: (1) property taxes, (2) state aid, and (3) miscellaneous taxes and fees. For this general subdivision type development the population (per capita) is distributed into housing units, which simply uses the entire fiscal expenditures and revenues as reported in a recent Annual Town Report, and allocated based upon population and/or residential unit without any discrete differentiations. Allocating average costing techniques, in this model, sometimes treats more expensive or newer homes disproportionately. Smaller scale developments, in and of themselves, rarely cause any large scale capital expenses to a community. School services represent a vast majority of the annual budget with other services being minimally impacted or measurable.

The most subjective component of the analysis is always the impact on the school population. Literature suggests just less than one student, 0.95, per residential unit. However using a direct ratio of the population for Grafton, of 18,885 and the total 2018-2019 student population of 3,173 in 6,939 households yields 0.45 students per household.

### **Scope Definition**

The scope of this analysis is directed at the Cluster Development option and is therefore contrasted to the conventional subdivision as the primary alternative. All fiscal related information and projections are derived from U.S. Census Bureau Website, Central Massachusetts Regional Planning Commission reports, and Grafton Comprehensive Plan.

## **(1) Natural Environment**

### **i. Air and Noise Pollution**

In the existing condition the site is undeveloped. Little or no air or noise pollution results from the existing condition.

This proposed project seeks to provide a residential cluster subdivision surrounded by open space, which will provide a wooded set back buffer from the existing streets and surrounding abutting houses. Setting the houses in the center of the site, surrounded by wooded areas on three sides and I-90 to the south, will isolate any long-term noise levels that would be associated with a residential neighborhood.

Short term impacts from construction vehicles and operations will be generally limited to the working hours. Heavy construction earthwork for roadways and utility installations will include truck traffic would access the site from North Street or Magnolia Lane. All construction equipment, per the Occupation Safety and Health Association, will have noise level thresholds. Occasionally equipment may exceed these noise levels, for example when a concrete mixer increases its mixer speed momentarily, however no significant excess noise will be realized by abutting/surrounding landowners during construction. On site gas fired electric generators may be used to build individual lots however most will rely on a temporary service pole, it being more economical. Additionally the use of small nail gun compressors will be common.

The project will abut the Mass Pike (I-90) located to the south. Proposed houses in the vicinity of I-90 will be subjected to some traffic noise.

Sources of potential air pollution during construction include dust emissions from exposed soils, and exhaust fumes from equipment and trucks. Houses now have high efficiency energy rated appliances, are well insulated and will produce significantly less air pollution than older houses. A few will likely have a wood stove or equivalent, and will add some woodsmoke during the colder months. With wind predominantly from the north-northwest in winter the smoke would drift toward the south. The vegetated buffers provide separation to abutters, and during colder months houses will typically have their windows closed.

### **ii. Storm Water**

Stormwater must be managed in accordance with rules and regulations promulgated by the both the Planning Board and the Conservation Commission in conformance with the Department of Environmental Protection (DEP) regulations. The regulations ensure control in the rate of runoff, infiltration to the groundwater, and pollution uptake and attenuation. A rigorous review will be provided by the local approving authorities including outside peer review of any final design submitted by the applicant. No untreated stormwater or excess peak discharge, over existing conditions, will be allowed.

iii. Land

Land cover at present is either woods or wetlands. Most of the proposed construction will take place in the wooded uplands with limited wetlands crossing. Soils have been mapped by the Natural Resource and Conservation Services (NRCS) as Paxton, Canton, and Woodbridge. These soils are generally glacial till uplands with a perched water table at 18 to 30 inches and slow permeability in the substratum.

During construction sedimentation and erosion controls will be implemented to mitigate and impacts on abutting property of wetland resources. All erosion controls will be selected and sized in accordance with the *Massachusetts Erosion and Sediment Control Guidelines for Urban and Suburban Areas*. Typically this will include staked haybales and silt fence, temporary sediment basin, diversion swales, etc.

iv. Plants and Wildlife

Plant communities are best understood in two separate categories: (1) wooded forest, (2) wetland areas. The area of site development is wooded forest with generally a mixture of red maples (*Acer rubrum*), with oak (*Quercus spp*) and white pine (*Pinus strobes*) with other populations of deciduous and coniferous trees present.

v. Water Supply

The 37 proposed houses will have an estimated water demand of approximately 16,280 gallons per day, according to DEP flow criteria (assuming 4 bedroom homes). The project would require a connection to the Municipal Water System in North Street and Magnolia Lane. On-site wells have not been proposed.

vi. Sewage Disposal

The proposed project will rely on the municipal sewer collection system. The 37 proposed houses will generate approximately 16,280 gallons per day, according to DEP flow criteria assuming 4 bedroom homes.

Sewer lines will be 8 inch diameter gravity collector mains throughout the development and service connections to each house individually. Due to the lower elevations of the site two sewer pump stations will be required and will eject to proposed manholes, one on Wesson Street, and one on Magnolia Lane.

**(2) Man-Made Environment**

i. Existing Neighborhood Land Use

Surrounding the site are single family houses on North Street, Wesson, and Magnolia Lane. The MassPike (I-90) bounds the site to the south.

ii. Zoning

Zoning for the site and surrounding area is Residential R 40 allowing for single family homes.

iii. Architecture

Architecture is mixed from newer colonials, to some older ranch style houses where houses are newer. Proposed homes would be compatible with the surrounding neighborhood.

**(3) Public Services**

- i. Schools should see an increase of 17 to 35 students as a result of this project's 37 houses (0.45 to 0.95 students per residential unit).
- ii. Police time and manpower required with this project would represent a need for 0.2 officers (Grafton Comprehensive Plan Table 2.4 of 0.64 Police Officers per 100 families).
- iii. Fire time and manpower, required with this project would represent a need for 0.2 Fire Fighters (Grafton Comprehensive Plan Table 2-4 of 0.48 per 100 families), but should be thought to be mitigated by advanced fire safety-retardant construction.
- iv. Recreation opportunities include the open space use for passive recreation with a possible walking trail.
- v. Solid Waste Disposal. Grafton generates about 1.6 tons per residential unit (1999 Comprehensive Plan), thus the new units would be similar. However recycling information was unavailable in the 1999 report. Recycling efforts have intensified in Massachusetts and thus would redirect some of this waste stream by as much as 40%.
- vi. A project of 37 single family residential lots would generate 37 AM and 42 PM peak hour vehicles. Trip generation is based upon ITE Trip Generation Manual, land use code 210. The attached report from Bristol Traffic & Transportation LLC provides an evaluation of the proposed intersections.
- vii. Highway impacts would be minimal. A newly designed and constructed subdivision road would not need maintenance for a number of years and subsequently, due to rigorous construction standards would require less than older town roads. Snow removal would be the biggest impact.

**(4) Aesthetics**

- i. Lighting is proposed to be limited to house mounted front door lights, and possibly a walkway post light on the lots. Street lighting can be provided within the right-of-way at the request of the Board.
- ii. Streetscape plants will include a mix of deciduous trees to provide a cohesive neighborhood character. Various hardscape features will include stone walls, school bus waiting areas, and walkways through the open space.

**(5) Planning**

Analyze the compatibility of the proposed development and its alternatives with the goals and objectives of the most recent Grafton Comprehensive Master Plan and the most recent Open Space Plan and any components of either Plan.

The application of the Flexible development comports with the Master Plan, which calls for protection of the environment and protection of property values by providing open space buffers to existing residential abutters and away from sensitive wetland resources to the greatest extent possible. The Master Plan calls to require 'flexible development' in the eastern portion of Town and to also adopt 'neighborhood development guidelines'. By concentrating the development into the central portion of the site the flexible development provides a cohesive neighborhood, protection of open space and increases setbacks.

**(6) Cost/Benefit Analysis**

Overall cost/benefit for the addition of 37 houses to the existing town count of approximately \$8.330 / units is projected as follows:

Tax revenue to Town from this projects new house:

Direct real estate tax only (per unit based upon valuation of \$500,000):

$$\$500,000 / 1000 \times \$16.66 = \$8.330^* / \text{unit}$$

Total of \$308.210

Based upon the FY2019 Grafton Budget Document, the average single family tax bill is \$6.263. As demonstrated above, the proposed homes will generate approximately \$2.067 above the average per unit.

\* There are other revenue streams to the town including but not limited to excise tax, personal property tax, miscellaneous reimbursements and grants, sales and meals tax at local commercial establishments. Newer and more expensive houses generally have more costly automobiles and other things that generate additional tax revenue over the town-wide averages.

### **Bonus Provision under Section 5.3.5.2:**

Under section 5.3.5.2 of the Zoning Bylaw, the Planning Board shall issue a FDSP containing more than the number of dwelling units permitted under Section 5.3.5.1 if the Board determines that the proposed development complies with a certain number of the Design Guidelines specific in Section 5.3.13. The proposed project has complied with seven of the Design Guidelines, which allows for a 15% increase in the allowable dwelling units. Those seven guidelines have been described below:

*5.3.13.f) The elements of the Flexible Development Plan (buildings, circulation, Common Land, landscaping, etc.) are arranged favorably with and so as to protect valuable natural environments such as stream valleys, outstanding vegetation, water bodies or scenic views.*

The proposed project has been designed to cluster most of the development on the west end of the site. This leaves a large area of open space to the east that far exceeds the minimum requirements. The minimum required open space is 29.3 acres with 14.6 acres of uplands. The proposed plan has provided 52.5 acres of open space with 33.1 acres of upland. This permanently protected open space includes undisturbed woodland habitat, and several wetland systems.

*5.3.13.g) Protection of major street appearance and capacity by avoiding development fronting such streets while contributing to the overall aesthetic quality of the development.*

The proposed lot development will occur off the proposed roadways on the interior of the site. The only development along North Street or Magnolia Lane will be the roadway entrances. The use is consistent with the surrounding neighborhood.

*5.3.13.h) Landscaping screens areas of low visual interest such as utility boxes, trash containers, and parking areas, and treats pedestrian systems and open space areas in a manner which contributes to their use and visual appearance.*

Landscape screening will be proposed at all utility boxes, and no common trash collection or parking areas have been proposed. The pedestrian system and open space will be enhanced with additional landscaping at the open space entrances and pedestrian woodland paths leading through the open space.

*5.3.13.i) Active recreational areas are suitably located and accessible to the residential units and adequate screening ensures privacy and quiet for neighboring residents. Where called for in the Town of Grafton Open Space and Recreation Plan and where warranted by the criteria established in that plan, and where feasible on a site, a large playing field is to be provided for recreational use.*

A playfield has been proposed in the open space accessible to the residential units through the woodland path. Adequate screening will be provided through the natural undisturbed buffer surrounding the field.

*5.3.13.j) The pedestrian circulation system is designed to assure that pedestrians can move safely and easily on the site and between properties and activities within the site and neighborhood.*

Pedestrian circulation has been provided along the roadways through sidewalks designed in accordance with the Grafton Subdivision Standards. Woodland paths have been proposed through the open space that connects the site to the open space, playfield and to abutting roadways.

*5.3.13.k) The Common Land shall be reasonably contiguous, coherent and if the tract of land abuts adjacent Common Land or other permanently protected open space, the Common Land shall be connected with such adjacent Common Land and with such permanently protected open space.*

The proposed common land is reasonably contiguous and coherent. There are no abutting areas of protected open space.

*5.3.13.l) Access to the Common Land shall be delineated by the use of design elements such as stone walls, woodland paths surfaced with bark mulch, etc.*

Additional landscaping will be provided at the entrances to the open space including stone walls, and a woodland path has been shown through the open space.

COPY

AUG 14 2019

EXHIBIT 1 f.

PLANNING BOARD  
GRAFTON, MA**North Street Subdivision**  
North Street & Magnolia Lane  
Grafton, MA

## REQUESTED WAIVER CONSIDERATIONS TO THE PLANNING BOARD

June 19, 2019

**Conventional and Flexible Development Plan:**

1. Subdivision Rules and Regulations §4.1.2.1.b to allow proposed grades within the right-of-way to be more than six feet above or below existing grade for the construction of the proposed roadways.

Per section 4.1.2.1, proposed grades within the right-of-way more than six feet above or below existing grade may be allowed if specifically authorized by the Planning Board in unusual topographic circumstances.

The proposed centerline grade depicted on the plans is greater than six feet above or below existing grade in the following locations to allow for the wetland crossing.

Flexible & Conventional Development Plans:  
Road A Station 0+50 to 5+90 & 15+00 to 15+50

2. Subdivision Rules and Regulations §4.1.3.5 from the requirement of property lines at street intersections being rounded or cut back. The property line and proposed right of way extends straight along the highway layout of the MassPike with a 90 degree intersection. The 30 foot pavement radius has been shown extending onto highway layout. Approval through MassDOT is required.

**Flexible Development Plan**

3. Subdivision Rules and Regulations §4.1.6 to allow a dead end length greater than 500 feet.

The waiver is required to allow the flexible development layout as proposed, which would allow for a substantial conservation benefit to be achieved. The plans have provided a secondary means of access to the site over an existing easement to Wesson Street. This emergency access is 20 feet wide and would connect to the end of the cul-de-sac on Road A.

The plans have not shown a roadway easement from the end of the dead end street to adjacent property since the abutting land would be permanently protected open space.

**COPY**

**EXHIBIT 1g.**

**RECEIVED**

**Proposed Subdivision Roadways**

Intersections at Existing  
North Street & Magnolia Lane  
Grafton, MA

**AUG 14 2019**

**PLANNING BOARD  
GRAFTON, MA**

---

**Intersections Site Distance Analysis**

---

**May 6, 2019**

*Prepared for:*

Circle Assets, LLC  
291 Main Street, Suite 8  
Northborough, MA 01532

*Prepared by:*

**BRISTOL TRAFFIC  
&  
TRANSPORTATION CONSULTING LLC**

*Traffic Studies, Roadway Designs, Intersection Improvements, Site Designs*

61 Hillsville Road  
N. Brookfield, MA 01535  
P: 508-867-9048 F: 508-867-9048

## TABLE OF CONTENTS

<u>Number</u>	<u>Page</u>
<b>1. INTRODUCTION .....</b>	<b>2</b>
1.1 Scope of Analysis.....	2
1.2 Sight Distance Measurement Reference Sources .....	2
<b>2. REFERENCE SOURCE MEASUREMENT METHODOLOGIES AND RECOMMENDED SIGHT DISTANCE DISTANCES .....</b>	<b>3</b>
2.1 AASHTO Stopping Sight Distance (SSD).....	3
2.2 AASHTO Intersection Sight Distance (ISD).....	4
<b>3. EXISTING MEASURED SIGHT DISTANCES.....</b>	<b>5</b>
3.1 Subdivision Road at Magnolia Lane.....	5
3.1.1 Stopping Sight Distances (SSD) .....	5
3.1.2 Intersection Sight Distances (ISD) .....	5
3.2 Subdivision Emergency Access/Egress Road at Wesson Street (Flex Plan).....	5
3.2.1 Stopping Sight Distances (SSD).....	5
3.2.2 Intersection Stopping Distances (ISD).....	5
3.3 Subdivision Road at North Street .....	6
3.3.1 Stopping Sight Distance (SSD).....	6
3.3.2 Intersection Sight Distance (SSD) .....	6
<b>4. STUDY CONCLUSIONS .....</b>	<b>6</b>
<b><u>APPENDICES</u> .....</b>	<b>8</b>
AASHTO Excerpts and desirable distances from Key Subsections referenced in report.	
Subsection 3.2.2 Stopping Sight Distance text.	
Table 3-1 SSD for safety based on speed.	
Subsection 9.5 Intersection Sight Distance text.	
Table 9-7 ISD for Left Turn Vehicle from Stop.	
Table 9-9 ISD for Right Turn Vehicle from Stop.	

## 1. INTRODUCTION

---

### 1.1 Scope of Analysis

This report documents the findings and conclusions of a sight distance analysis conducted for a proposed preliminary residential subdivision roadway access to North Street and Magnolia Lane as well as an emergency only access/egress to Wesson Street, each located in Grafton, MA. Two preliminary plans for the subdivision are being submitted to the town planning board for review. One plan is a standard subdivision layout with single access points to both North Street and Magnolia Lane roadways. The second plan is for a reduced house lot sized Flex Plan footprint layout that creates significantly larger areas dedicated to open space. The second plan utilizes access to Magnolia Lane and North Street at the same locations as the first plan. However the second plan also includes an emergency only access way creating a site intersection onto Wesson Street that will be restricted from day to day use by the residents of this proposed subdivision option. This emergency access/egress is to be provided due to the creation of a cul-de-sac road layout that provides an emergency access/egress roadway from the cul-de-sac to Wesson Street only should the main access to North Street be temporarily unusable.

### 1.2 Sight Distance Measurement Reference Sources

Sight distance available for the vehicles approaching the proposed subdivision road intersections and available for the vehicles exiting the subdivision roadways onto North Street, Magnolia Lane and at the potential location on Wesson Street were each field measured. These measurements were taken in accordance with requirements in both the American Association of State Highway and Transportation Officials (AASHTO) publication titled A Policy on Geometric Design of Highways and Streets, 2018, 7<sup>th</sup> Edition and included in the Massachusetts Department of Transportation (MassDOT) Highway Division publication titled 2006 Massachusetts Highway Department Project Development & Design Guide that quotes the requirements of the same AASHTO document. These are the guidelines currently used to determine available and standards for providing sight distances at intersections.

Stop line locations are established in the Federal Highway Administration (FHWA) 2009 publication titled the Manual of Uniform Traffic Control Devices (MUTCD) with revisions in 2012.

## 2. REFERENCE SOURCE MEASUREMENT METHODOLOGIES AND RECOMMENDED SIGHT DISTANCES

---

### 2.1 AASHTO Stopping Sight Distance (SSD)

Drivers approaching an intersection or any obstacle encountered on a roadway require time to recognize that the object (or vehicle) that is in its travel path is a hazard necessary to react to. They also require the time needed to actually apply the brakes and either slow or stop the vehicle at a reasonable deceleration rate (not skidding or an uncomfortably harsh stopping maneuver). This total time is known as the perception and reaction time plus actual braking time. During this time period the vehicle travels at the approach speed then stops safely or slows significantly enough to avoid the obstacle if provided with the appropriate length of sight distance.

This perception/reaction and stopping distance length traveled before coming to a stop is dependent on the speed the vehicle is traveling and the available length of visibility on the through roadway. North Street has a 30 MPH speed limit that requires a car to have 200 feet of available sight distance to safely stop on wet pavement without excessive, aggressive stopping. The two other streets analyzed lacked speed signage and based on their closeness of housing and width of roadways it is assumed 30 MPH is a reasonable speed for those as well.

The object height that AASHTO has determined to be the reasonable height for an approaching driver to spot and identify as a hazard to them is 2.0 feet high, as measured above the road surface. This is the average height of a car headlight or tail light, so the approaching driver can avoid impact with a vehicle stopped in the approaching drivers lane. The height AASHTO defines as typical for the normal drivers eye above the road surface is 3.5 feet, and is used to measure stopping sight distance..

So this sets the method to measure stopping sight distance available on any non-stop controlled approach to an intersection. The sight line needs to be clear from 3.5 ft for the driver looking for an object 2 feet above the lane surface, at any intersection or along the through roadway.

This measurement is taken in the field for all through, uncontrolled approaches to verify that vertical curvature of the road surface or a horizontal curve do not create a high point or side of road blockage within the required 200 foot safe stopping distance. (see Table 3-1 in Appendix)

## 2.2 AASHTO Intersection Sight Distance (ISD)

Intersection sight distance is described in the AASHTO Policy publication Section 9.5. (see Appendix for pertinent pages from this section).

Intersection sight distance (ISD) is measured differently than Stopping Sight Distance (SSD) and the method will be described here.

An important point made in the AASHTO policy and also repeated in the MassDOT Highway guide book, is included in the Appendix, the fourth paragraph on Page 9-35, which is in Section 9.5.1, General Conditions. The AASHTO paragraph states "If the available sight distance for an entering or crossing vehicle is at least equal to the appropriate stopping sight distance for the major road, then drivers have sufficient sight distance to anticipate and avoid collisions. However, in some cases, a major-road vehicle may need to slow or stop to accommodate the maneuver by the minor road vehicle. To enhance traffic operations, intersection sight distances that exceed stopping sight distances are desirable along the major road." This defines the minimum ISD that is safe and equal to the SSD. In our case that SSD is 200 feet for 30 MPH.

Keep in mind that the subdivision road intersections with town roads will have side street stop sign controls so side road vehicles will stop to look for oncoming vehicles. Section 9.5 covers all types of intersection controls from no stops on four legs to 4-way stop or side road only stops.

ISD is measured from the driver's eye height on the side street to the drivers eye height of the approaching vehicle. Both are set at 3.5 feet above the road. This indicates that if the stopped side road vehicle driver can see the oncoming vehicle then the oncoming vehicle can also see the side road vehicle. Additionally, the side road vehicle is assumed to be set back from the edge of travel way of the through road. The set back distance a majority of vehicles stop on side roads was found to be "6.5 ft or less" from front grill of car to edge of through roadway. This places the drivers eye an additional 8 ft from the front grill of the stopped car for the majority of cars in the US. So measurements are made from 14.5 ft from edge of roadway to the left and right looking at the middle of the approaching lane, to determine the intersection sight distance (ISD) available.

The MUTCD reference publication produced by the Federal Highway Administration (FHWA) states that stop line stripes should be placed 4 ft from crosswalks or 4 ft from an edge of road, with the option of being farther away on side roads if conditions dictate. For the proposed new

subdivision road intersections at North Street, Magnolia Lane and for the Flex option plan also at Wesson Street, the proposal is to place the stop lines at 4 ft from edge of through roadway. In the above AASHTO recommended location for measuring the sight triangle the car will be assumed to stop with the front grill 2.5 ft prior to the stop line.

AASHTO recommends an ISD for a stopped vehicle turning left onto a 30 mph through roadway to be 335 ft (See Table 9-7 in the appendix) for operational efficiency, not safety reasons. They recommend an ISD for a stopped vehicle turning right onto a 30 MPH roadway to be 290 ft (see Table 9-9 in the appendix) for operational efficiency.

### **3. MEASURED SIGHT DISTANCES AT PROPOSED NEW INTERSECTIONS**

---

#### **3.1 Subdivision Road at Magnolia Lane**

3.1.1 Stopping Sight Distance (SSD) measured from the northwest (left) is greater than 500 feet. Measured from the southeast (right) it is 265 feet. Both exceed the 200 foot safety standard by AASHTO for 30 MPH.

3.1.2 Intersection Sight Distance (ISD) measured for a car turning left is greater than 400 feet to the northwest (left) and is 360 feet to the east, both exceeding the AASHTO desirable 335 feet. For a car turning right the ISD is greater than 400 feet to the northwest (left) that exceeds the desirable 290 feet listed by AASHTO.

#### **3.2 Subdivision Emergency Only Road at Wesson Street (Flex Plan Only)**

3.2.1 Stopping Sight Distance (SSD) measured from the West is greater than 500 feet. Measured from the east (right) it is greater than 500 feet. Both exceed the 200 foot safety standard by AASHTO.

3.2.2 Intersection Sight Distance (ISD) measured for a car turning right is greater than 500 feet to the left, which exceeds the AASHTO desirable 290 foot line of sight. For a car turning left the sight line to the left is greater than 500 feet, which exceeds the AASHTO desirable 335 feet and to the right the sight line is approximately 130 feet at the 14.5 foot setback from edge of road to grill of car. However if the car pulls forward 2.5 feet so the grill is at the stop line 4 feet from the edge of road, the sight line to the east increases to 350 feet which exceeds to AASHTO desirable distance for operational efficiency.

Keeping in mind that in an unlikely event that North Street roadway intersection becomes inaccessible for a period, then and only then would the Wesson Street emergency roadway be used.

### 3.3 Subdivision Road at North Street

3.1.1 Stopping Sight Distance (SSD) measured from the south (left) is greater than 500 feet. Measured from the north (right) it is 315 feet. Both exceed the 200 foot AASHTO safety standard for the approaching car to be able to safely stop, should that become necessary.

3.1.2 Intersection Sight Distance (ISD) measured for a car turning left is 167 feet to the south and 350 feet to the north, exceeding the desirable 335 feet to the north. However if the side street car moves forward so the car front grill is at the stop line, 4 ft from the edge of road, instead of stopping "6.5 feet or less" as the average distance was established by AASHTO, the vehicle is still not close to the road edge with 4 feet of distance between the car and pavement. Then the (ISD) sight line to the south increases to be the AASHTO desirable 335 feet for operational efficiency, not for safety. Should the car move so the front tires are at the stop line, the line of sight is increased further to 510 feet. This is with the grill of the car still 1.5 to 2 feet from the road pavement.

The reason the sight line to the south is reduced when the car grill is the 6.5 feet from the road pavement is the existing concrete parapet post for the bridge over the Mass Turnpike to the south. Moving the car forward only 2.5 feet allows the driver sitting 8 feet behind the grill of the average car to see in front of the concrete post to the full 335 feet desirable sight line.

## 4. STUDY CONCLUSIONS

---

The study indicates that each of the three potential subdivision roadway intersections with existing town roads provide adequate intersection and stopping site distances that will not put the through vehicles or the side street vehicles in danger. As AASHTO reference states the Stopping Site Distance is the most important criteria and each intersection satisfies that distance. A secondary sight distance is the intersection sight distance that is desirable to enhance traffic operations. However their statement as quoted in the report does make it clear that if the side street vehicle driver has available to them the Stopping Sight Distance needed for the oncoming

vehicle to stop, then drivers have sufficient sight distance to anticipate and avoid collisions.

Another finding is that the AASHTO assumed average stopping location distance from the main road being "6.5 feet or less" therefore the distance has been set at 6.5 feet for the front of the car and the driver is typically another 8 feet back from the front of the vehicle, so totaling 14.5 feet. This distance assumes that the front grill of the car is at minimum 2 feet from the stop line which is set at 4 feet from the through street edge. If the car pulls forward to the stop line in each of these intersections the Intersection Sight Distance is available so traffic operations can be enhanced at that stopping point.

Overall the review and field measurements indicate that the sight distances available are sufficient to avoid collisions and improve operational efficiency at all three of the potential intersections.

## APPENDIX

---

AASHTO Excerpts and Tables listing desirable distances, from Key Subsections referenced in report.

Subsection 3.2.2 Stopping Sight Distance text.

Table 3-1 SSD for safety based on speed.

Subsection 9.5 Intersection Sight Distance text.

Table 9-7 ISD for Left Turn Vehicle from Stop.

Table 9-9 ISD for Right Turn Vehicle from Stop.

# A Policy on Geometric Design of Highways and Streets

2018  
7th Edition



criteria and guidance applicable to specific functional classifications of highways and streets are presented in Chapters 5 through 8.

Four aspects of sight distance are discussed below: (1) the sight distances needed for stopping, which are applicable on all roads and streets; (2) the sight distances needed for the passing of overtaken vehicles, applicable only on two-lane highways; (3) the sight distances needed for decisions at complex locations; and (4) the criteria for measuring these sight distances for use in design. The design of alignment and profile to provide sight distances and to satisfy the applicable design criteria are described later in this chapter. The special conditions related to sight distances at intersections are discussed in Section 9.5.

### 3.2.2 Stopping Sight Distance

Sight distance is the length of the roadway ahead that is visible to the driver. The available sight distance on a roadway should be sufficiently long to enable a vehicle traveling at or near the design speed to stop before reaching a stationary object in its path.

Stopping sight distance is the sum of two distances: (1) the distance traversed by the vehicle from the instant the driver sights an object necessitating a stop to the instant the brakes are applied, and (2) the distance needed to stop the vehicle from the instant brake application begins. These are referred to as brake reaction distance and braking distance, respectively.

#### 3.2.2.1 Brake Reaction Time

Brake reaction time is the interval from the instant that the driver recognizes the existence of an obstacle on the roadway ahead that necessitates braking until the instant that the driver actually applies the brakes. Under certain conditions, such as emergency situations denoted by flares or flashing lights, drivers accomplish these tasks almost instantly. Under most other conditions, the driver needs not only to see the object but also to recognize it as a stationary or slowly moving object against the background of the roadway and other objects, such as walls, fences, trees, poles, or bridges. Such determinations take time, and the amount of time needed varies considerably with the distance to the object, the visual acuity of the driver, the driver's reaction time, the atmospheric visibility, the type and the condition of the roadway, and the nature of the obstacle. Vehicle speed and roadway environment probably also influence reaction time. Normally, a driver traveling at or near the design speed is more alert than one traveling at a lesser speed. A driver on a street in an urban area confronted by innumerable potential conflicts with parked vehicles, driveways, and cross streets is also likely to be more alert than the same driver on a limited-access facility where such conditions should be almost nonexistent. However, a driver on an urban street faces a high mental workload in trying to monitor additional conflicts, so there is no assurance that the driver will be able to quickly detect a need for immediate action from among the many potential sources of conflict.

U.S. Customary	Metric	(3-1)
$d_B = 1.075 \frac{V^2}{a}$ <p>where:</p> <p><math>d_B</math> = braking distance, ft</p> <p><math>V</math> = design speed, mph</p> <p><math>a</math> = deceleration rate, ft/s<sup>2</sup></p>	$d_B = 0.039 \frac{V^2}{a}$ <p>where:</p> <p><math>d_B</math> = braking distance, m</p> <p><math>V</math> = design speed, km/h</p> <p><math>a</math> = deceleration rate, m/s<sup>2</sup></p>	

Studies documented in the literature (19) show that most drivers decelerate at a rate greater than 14.8 ft/s<sup>2</sup> [4.5 m/s<sup>2</sup>] when confronted with the need to stop for an unexpected object in the roadway. Approximately 90 percent of all drivers decelerate at rates greater than 11.2 ft/s<sup>2</sup> [3.4 m/s<sup>2</sup>]. Such decelerations are within the driver's capability to stay within his or her lane and maintain steering control during the braking maneuver on wet surfaces. Therefore, 11.2 ft/s<sup>2</sup> [3.4 m/s<sup>2</sup>] (a comfortable deceleration for most drivers) is recommended as the deceleration threshold for determining stopping sight distance. Implicit in the choice of this deceleration threshold is the assessment that most vehicle braking systems and the tire-pavement friction levels of most roadways are capable of providing a deceleration rate of at least 11.2 ft/s<sup>2</sup> [3.4 m/s<sup>2</sup>]. The friction available on most wet pavement surfaces and the capabilities of most vehicle braking systems can provide braking friction that exceeds this deceleration rate.

Table 3-1. Stopping Sight Distance on Level Roadways

U.S. Customary					Metric				
Design Speed (mph)	Brake Reaction Distance (ft)	Braking Distance on Level (ft)	Stopping Sight Distance		Design Speed (km/h)	Brake Reaction Distance (m)	Braking Distance on Level (m)	Stopping Sight Distance	
			Calculated (ft)	Design (ft)				Calculated (m)	Design (m)
15	55.1	21.6	76.7	80	20	13.9	4.6	18.5	20
20	73.5	38.4	111.9	115	30	20.9	10.3	31.2	35
25	91.9	60.0	151.9	155	40	27.8	18.4	46.2	50
30	110.3	86.4	196.7	200	50	34.8	28.7	63.5	65
35	128.6	117.6	246.2	250	60	41.7	41.3	83.0	85
40	147.0	153.6	300.6	305	70	48.7	56.2	104.9	105
45	165.4	194.4	359.8	360	80	55.6	73.4	129.0	130
50	183.8	240.0	423.8	425	90	62.6	92.9	155.5	160
55	202.1	290.3	492.4	495	100	69.5	114.7	184.2	185
60	220.5	345.5	566.0	570	110	76.5	138.8	215.3	220
65	238.9	405.5	644.4	645	120	83.4	165.2	248.6	250
70	257.3	470.3	727.6	730	130	90.4	193.8	284.2	285
75	275.6	539.9	815.5	820	140	97.3	224.8	322.1	325
80	294.0	614.3	908.3	910					
85	313.5	693.5	1007.0	1010					

Note: Brake reaction distance predicated on a time of 2.5 s; deceleration rate of 11.2 ft/s<sup>2</sup> [3.4 m/s<sup>2</sup>] used to determine calculated sight distance.

desired direction of travel, free from the potential for conflicts to appear suddenly, and consistent in design with the portions of the roadway just traveled.

The combination of vertical and horizontal curvature should allow adequate sight distance at an intersection. As discussed in Section 3.5, "Combinations of Horizontal and Vertical Alignment," a sharp horizontal curve following a crest vertical curve is undesirable, particularly on intersection approaches.

## 9.5 INTERSECTION SIGHT DISTANCE

### 9.5.1 General Considerations

Each intersection has the potential for several different types of vehicular conflicts. The possibility of these conflicts actually occurring can be greatly reduced through the provision of proper sight distances and appropriate traffic controls. The avoidance of conflicts and the efficiency of traffic operations still depend on the judgment, capabilities, and response of each individual driver.

Stopping sight distance is provided continuously along each roadway so that drivers have a view of the roadway ahead that is sufficient to allow drivers to stop. The provision of stopping sight distance at all locations along each roadway, including intersection approaches, is fundamental to intersection operation.

Vehicles are assigned the right-of-way at intersections by traffic-control devices or, where no traffic-control devices are present, by the rules of the road. A basic rule of the road, at an intersection where no traffic-control devices are present, requires the vehicle on the left to yield to the vehicle on the right if they arrive at approximately the same time. Sight distance is provided at intersections to allow drivers to perceive the presence of potentially conflicting vehicles. This should occur in sufficient time for a motorist to stop or adjust their speed, as appropriate, to avoid colliding in the intersection. The methods for determining the sight distances needed by drivers approaching intersections are based on the same principles as stopping sight distance, but incorporate modified assumptions based on observed driver behavior at intersections.

The driver of a vehicle approaching an intersection should have an unobstructed view of the entire intersection, including any traffic-control devices. At uncontrolled or minor approach stop controlled intersections, sight distance along the intersecting roadway should be sufficient to permit the driver on the minor road to anticipate and avoid potential collisions. If the available sight distance for an entering or crossing vehicle is at least equal to the appropriate stopping sight distance for the major road, then drivers have sufficient sight distance to anticipate and avoid collisions. However, in some cases, a major-road vehicle may need to slow or stop to accommodate the maneuver by a minor-road vehicle. To enhance traffic operations, intersection sight distances that exceed stopping sight distances are desirable along the major road. Specific

Table 9-7. Design Intersection Sight Distance—Case B1, Left Turn from Stop

U.S. Customary				Metric			
Design Speed (mph)	Stopping Sight Distance (ft)	Intersection Sight Distance for Passenger Cars		Design Speed (km/h)	Stopping Sight Distance (m)	Intersection Sight Distance for Passenger Cars	
		Calculated (ft)	Design (ft)			Calculated (m)	Design (m)
15	80	165.4	170	20	20	41.7	45
20	115	220.5	225	30	35	62.6	65
25	155	275.6	280	40	50	83.4	85
30	200	330.8	335	50	65	104.3	105
35	250	385.9	390	60	85	125.1	130
40	305	441.0	445	70	105	146.0	150
45	360	496.1	500	80	130	166.8	170
50	425	551.3	555	90	160	187.7	190
55	495	606.4	610	100	185	208.5	210
60	570	661.5	665	110	220	229.4	230
65	645	716.6	720	120	250	250.2	255
70	730	771.8	775	130	285	271.1	275
75	820	826.9	830				
80	910	882.0	885				

Note: Intersection sight distance shown is for a stopped passenger car to turn left onto a two-lane highway with no median and grades 3 percent or less. For other conditions, the time gap should be adjusted and the sight distance recalculated.

Sight distance design for left turns at intersections on divided roads or streets should consider multiple design vehicles and median width. If the design vehicle used to determine sight distance for an intersection on a divided road or street is larger than a passenger car, then sight distance for left turns should be checked for that selected design vehicle and for a passenger car as well. If the median on a divided road or street is wide enough to store the design vehicle with a clearance to the through lanes of approximately 3 ft [1 m] at both ends of the vehicle, no separate analysis for the departure sight triangle for left turns is needed on the minor-road approach for the near roadway to the left. In most cases, the departure sight triangle for right turns (Case B2) will provide sufficient sight distance for a passenger car to cross the near roadway to reach the median. Possible exceptions are addressed in the discussion of Case B3.

If the design vehicle can be stored in the median with adequate clearance to the through lanes, a departure sight triangle to the right for left turns should be provided for that design vehicle turning left from the median roadway. Where the median is not wide enough to store the design vehicle, a departure sight triangle should be provided for that design vehicle to turn left from the minor-road approach.

Table 9-9. Design Intersection Sight Distance—Case B2, Right Turn from Stop.

U.S. Customary				Metric			
Design Speed (mph)	Stopping Sight Distance (ft)	Intersection Sight Distance for Passenger Cars		Design Speed (km/h)	Stopping Sight Distance (m)	Intersection Sight Distance for Passenger Cars	
		Calculated (ft)	Design (ft)			Calculated (m)	Design (m)
15	80	143.3	145	20	20	36.1	40
20	115	191.1	195	30	35	54.2	55
25	155	238.9	240	40	50	72.3	75
30	200	286.7	290	50	65	90.4	95
35	250	334.4	335	60	85	108.4	110
40	305	382.2	385	70	105	126.5	130
45	360	430.0	430	80	130	144.6	145
50	425	477.8	480	90	160	162.6	165
55	495	525.5	530	100	185	180.7	185
60	570	573.3	575	110	220	198.8	200
65	645	621.1	625	120	250	216.8	220
70	730	668.9	670	130	285	234.9	235
75	820	716.6	720				
80	910	764.4	765				

Note: Intersection sight distance shown is for a stopped passenger car to turn right onto or to cross a two-lane roadway with no median and with grades of 3 percent or less. For other conditions, the time gap should be adjusted and the sight distance recalculated.

#### 9.5.3.2.3 Case B3—Crossing Maneuver from the Minor Road

In most cases, the departure sight triangles for left and right turns onto the major road, as described for Cases B1 and B2, will also provide adequate sight distance for minor-road vehicles to cross the major road. However, in the following situations, it is advisable to check the availability of sight distance for crossing maneuvers:

- where left or right turns or both are not permitted from a particular approach and the crossing maneuver is the only legal maneuver;
- where the crossing vehicle would cross the equivalent width of more than six lanes; or
- where substantial volumes of heavy vehicles cross the roadway and steep grades that might slow the vehicle while its back portion is still in the intersection are present on the departure roadway on the far side of the intersection.

The equation for intersection sight distance in Case B1 (see Equation 9-1) is used again for the crossing maneuver except that time gaps ( $t_g$ ) are the same as those for the Right Turn from Stop maneuver, which presents time gaps and appropriate adjustment factors to determine the intersection sight distance along the major road to accommodate crossing maneuvers. At divid-